Original Article

Class II correction in orthodontic patients utilizing the Mandibular Anterior Repositioning Appliance (MARA)

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ABSTRACT

Objectives: To evaluate skeletal and dentoalveolar changes produced by the Mandibular Anterior Repostioning Appliance (MARA) in the treatment of Class II malocclusion in adolescent patients.

Materials and Methods: Lateral cephalograms of 24 patients, mean age 12.40 years, with a Class II malocclusion consecutively treated with MARA were compared with a historical control group. Changes were evaluated using the Pancherz superimposition and grid analysis pre- and posttreatment. Independent sample *t*-test, Mann-Whitney *U*-test, and Pearson correlation coefficient analysis were performed.

Results: Significant differences were seen between the treatment and control groups during the 12 month period. Improvement in Class II relationship in the MARA group resulted from skeletal and dentoalveolar changes. There was a 7-mm molar correction and a 4.7-mm overjet reduction. There was also an increase in the mandibular base of 3.3 mm with the lower molar and incisor coming forward 2.6 mm and 2.2 mm, respectively. No significant headgear effect was shown on the maxilla. The maxillary incisor position remained unchanged, whereas the molar distalized 1.8 mm. The anterior lower facial height had an overall increase of 2.2 mm.

Conclusions: The MARA was successful in achieving a Class I molar relationship and reducing the overjet in Class II malocclusions. This was the result of both skeletal and dentoalveolar changes. (*Angle Orthod.* 2019;89:404–410.)

KEY WORDS: Class II malocclusion; MARA; Functional appliance; Class II therapy

INTRODUCTION

Treatment of Class II malocclusion is one of the most frequent challenges facing orthodontists in everyday practice. It has been estimated that about 35% of the US population has a Class II malocclusion based on overjet.[1] Class II malocclusion, unlike what the Angle sagittal dental classification implies, is a multifactorial entity that involves a combination of one or more dental and skeletal factors.[2] Treatment of Class II malocclusions has varied with time and place.[3] The Herbst appliance has been considered the gold standard for a fixed functional appliance over the past half century.[4,5] A more recent fixed functional appliance that is gaining popularity, especially in the United States, is the Mandibular Anterior Repostioning Appliance (MARA) originally developed by Toll.[6,7] Scientific studies on the MARA have been limited. Pangrazio-Kulbersh et al.[8] evaluated the treatment effects of the MARA in a cephalometric study of patients age 9.5 to 15.8 years with a mean treatment time of 10.7 months. Class II correction was achieved by means of both skeletal and dental changes. Proper molar relationship was obtained by 47% skeletal changes and 53% dental changes. Skeletal changes showed an increase in mandibular length and anterior and posterior facial heights but minimal restraint of the maxilla. The dental effects included distalization of maxillary molars, mesialization of molars and incisors, and mild proclination of the lower incisors.[8] Siara-Olds et al.[9] evaluated the long-term dentoskeletal changes in patients treated with Bionator, Herbst, Twin Block, and MARA functional appliances with matched con-

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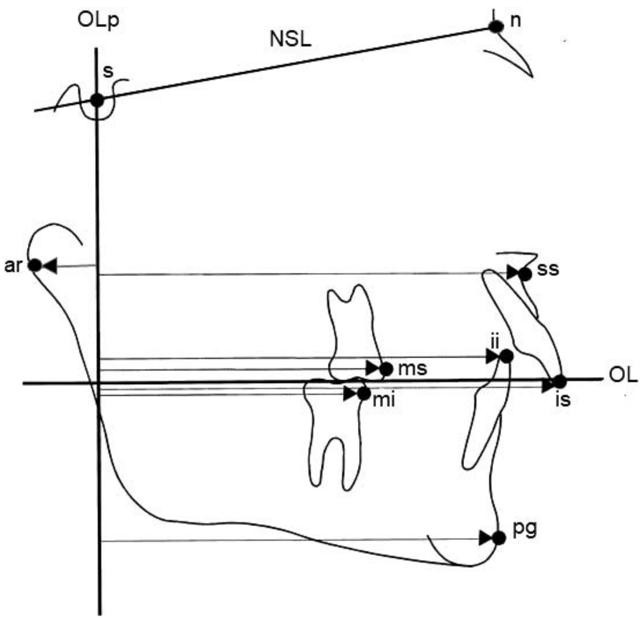

Figure 1. Cephalometric reference lines and measuring points.

trols. No significant long-term dentoskeletal differences were observed among the various treatment groups and matched controls.[9]

Comparison between Class II functional appliance studies has been problematic due to differences in protocols. While systematic reviews on the MARA and fixed functional appliances have concluded that they were effective, the percentage of correction from skeletal and dental components varied greatly among the studies.[10–13] A significant issue has been the variation in cephalometric analyses and parameters.[14] In the era of evidence-based orthodontics, it is useful to conduct additional clinical studies with rigorous protocol and analysis to help discern findings and contribute to the knowledge base.

The aim of the present cephalometric study was to analyze the skeletal and dental treatment effects in the sagittal dimension with the MARA in adolescent patients with Class II malocclusion using the Pancherz analysis. This analysis was specifically designed to overcome the shortcomings of the traditional array of analyses in evaluation of Class II correction in the sagittal linear direction.[5] It readily identifies the skeletal and dental components contributing to the overjet and molar correction.

MATERIALS AND METHODS

Institutional review board approval was obtained to conduct this study from Rutgers University. Records of 24 white adolescent patients (9 girls, 16 boys) consecutively treated with the MARA followed by fixed appliances were used for the study, All were treated by a single private practitioner who had extensive experience with the MARA (Dr Bogdan). Inclusion criteria were (1) complete records with readily identifiable radiographic landmarks, (2) no previous orthodontic treatment, (3) Class II dental malocclusion with at least a cusp to cusp molar and canine relationship present, (4) an anterior deep bite (>10%), and (5) ANB angle of at least 4.0°.

The MARA (AOA, Sturtevant, Wis) was designed as recommended.[15] Cast full coverage crowns were placed on the first molars with occlusal vents. Soldered occlusal rests extending to the erupted second molars were used to prevent bite opening. Soldered extension arms with occlusal rests on first premolars were used for additional anchorage. A soldered lower lingual arch was present. A maxillary expansion device with NiTi springs was incorporated to give a gentle, consistent dentoalveolar force if expansion was needed, For moderate to severe cases, the appliance was initially advanced to half the original overjet and then incrementally every 10 weeks to Class I occlusion for an average duration of 12 months.

Lateral cephalograms were taken at time 1 (T1) before placement of the MARA and at time 2 (T2), the end of active MARA treatment. The control group comprised comparable patients with Class II malocclusion from the legacy University of Michigan Growth Study. Thirteen patients, 6 males and 7 females, matched the criteria for Class II dental skeletal features at T1, were of a similar age (mean = 11 years 10 months), and had longitudinal cephalograms over the same period. Historical controls were used due to the difficulty of finding untreated patients and because of the ethical issues of leaving patients with Class II malocclusion untreated at this age.

Cephalometric Analysis

Sagittal changes were analyzed by superimposing lateral cephalogram tracings using a reference grid and linear measurements based on the Pancherz technique.[5] The grid was established by the occlusal plane with the perpendicular passing through Sella on the cephalogram. The grid from the initial radiograph was then transferred to the subsequent radiographs by superimposing the grid on the SN line, with the registration on Sella. All linear measurements were performed on lines parallel with OLp (Figure 1). The tracings and measurements were carried out by one examiner and validated by a second examiner. Any disagreement was resolved by retracing after discussion. Linear measurements were made to the nearest 0.5 mm and angular measurements to the nearest 0.5°. Superimpositions were conducted manually. All ceph-

Table 1. Descriptive Statistics for T1 and T2, and *P* Values for Comparisons of Measurement at T1 Between the Two Groups[a]

	MARA Group (n = 24)				Control Group (n = 13)				
	T1		T2		T1		T2		
Dependent Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*P* Value for Group Comparison at T1
Overjet, is/Olp minus ii/Olp	7.65	2.48	2.93	1.34	5.58	1.55	5.40	1.28	.010*
Molar relation, ms/Olp minus mi/OLp	1.43	1.92	–5.57	1.31	0.77	1.22	0.35	1.09	.270
Maxillary base, ss/Olp	80.67	4.46	81.34	4.78	74.15	5.50	75.02	5.66	<.001*
Mandibular base, pg/Olp	81.28	5.61	84.55	6.87	75.08	7.77	76.12	8.55	.008*
Condylar head, ar/Olp	8.44	3.37	8.90	3.59	9.77	5.57	10.67	5.50	.369
Mandibular length, pg/Olp+ar/Olp	89.72	5.50	93.45	6.56	84.85	7.76	86.79	9.40	.033* (NP)
Maxillary incisor, is/Olp	90.3	4.7	91.0	5.9	80.9	5.8	82.3	7.4	<.001*
Mandibular incisor, ii/OLp	82.7	5.2	88.1	6.2	75.3	6.5	77.0	7.5	<.001*
Maxillary molar, ms/Olp	57.4	4.5	56.3	5.0	51.4	5.2	53.9	6.2	<.001*
Mandibular molar, mi/Olp	56.0	4.7	61.9	5.3	50.6	5.6	53.9	6.6	.004*
Mandibular incisor inclination, IMPA	97.19	8.23	102.08	9.44	95.19	5.93	96.03	5.63	.446
Maxillary incisor inclination, U1-SN	103.85	8.42	100.79	9.82	107.19	5.61	107.37	5.86	.263 (NP)
Convexity, G-Sn-Pg (°)	19.1	5.4	15.9	5.1	–	–	–	–	–
Upper facial height, N-ANS	54.26	2.98	55.22	2.72	53.19	4.15	55.06	3.63	.372
Total facial height, N-Me	118.18	6.31	122.36	6.30	107.23	7.53	109.25	7.18	<.001*
Facial height ratio, UFH:TFH	0.46	0.03	0.45	0.03	0.50	0.03	0.50	0.03	<.001*

[a] MARA indicates Mandibular Anterior Repostioning Appliance; NP, using nonparametric (Mann-Whitney *U*) test; T1, time 1; T2, time 2.
* $P < .05$; – Missing data.

alograms were standardized to a magnification error of 8%.

Statistical Analysis

A sample size of 24 was calculated based on a power of 0.80 and alpha of 0.05. To determine accuracy of the method, 10 randomly chosen cephalograms were retraced, remeasured, and superimposed 2 weeks apart by one examiner using the same landmarks and variables included in this study. Measurements were calculated using the intraclass correlation coefficient and showed high reliability (between 0.90 and 0.98) and were all within 1 mm or 1.0° of the original. The average error did not exceed 0.5 mm or 0.5°.

Mean and standard deviation were calculated for each type of measurement. Since the sample size was small, normal distribution was checked for each type of measurement at T1 and the change from T1 to T2 using Shapiro-Wilk normality tests and normal Q-Q plot. If the test failed to reject the hypothesis of normality, independent sample *t*-test was used to compare the mean measurement between the two groups; otherwise, Mann-Whitney *U*-test was used for comparison. The correlation between the overjet measurement at T1 and the change of other measurement was analyzed with the Pearson correlation coefficient. All data analysis was done using IBM SPSS (version 24, IBM, Armonk, NY) and significance level was set to $P < .05$.

RESULTS

Independent sample *t*-test or Mann-Whitney *U*-test showed that there were significant differences in the following measurements between the MARA and control groups at T1: overjet, maxillary base, mandibular base, mandibular length, maxillary incisor, facial height, and upper to total facial height (Table 1). For these measurements, the MARA group had significantly higher means than the control group at T1. The test results also showed that there were significant differences between the MARA and control groups in the changes in measurement of overjet, molar relation, mandibular base, mandibular incisor, maxillary molar, mandibular molar, mandibular incisor inclination, facial height, and upper to total facial height (Table 2).

In the MARA group, there was normalization of the molar relationship to a Class I of 7 mm. Maxillary molars were distalized 1.76 mm, and the mandibular molars protracted 2.65 mm. An increase in mandibular length of approximately 3.73 mm also helped reduce facial convexity. There was no retrusive effect on the maxilla or the maxillary incisors. A significant reduction in overjet of approximately 4.72 mm ($P < .001$) was achieved. Protrusion and proclination of mandibular incisors was 2.15 mm and 4.9°, respectively. A significant increase was found in the anterior lower facial height, and protrusion of the lips changed minimally. The relative skeletal and dental changes contributing to molar and overjet correction are shown in Figures 2 and 3, respectively.

Table 2. Descriptive Statistics for Changes (T2-T1), and *P* Values for Comparisons of Change Between the Two Groups[a]

	Changes (T2-T1)						
	MARA Group (n = 24)		Control Group (n = 13)		Group Difference		
Dependent Variable	Mean	SD	Mean	SD	Mean	SE	*P* Value
Overjet, is/Olp minus ii/Olp	–4.72	2.26	–0.18	0.52	–4.54	0.48	<.001*
Molar relation, ms/Olp minus mi/OLp	–7.00	2.08	–0.41	0.71	–6.58	0.47	<.001*
Maxillary base, ss/Olp	0.67	1.22	0.87	1.45	–0.19	0.45	.669
Mandibular base, pg/Olp	3.26	2.76	1.05	2.16	2.22	0.88	.016* (NP)
Condylar head, ar/Olp	0.47	1.40	0.90	1.65	–0.44	0.51	.276 (NP)
Mandibular length, pg/Olp+ar/Olp	3.73	2.73	1.95	3.14	1.78	0.99	.081
Maxillary incisor, is/Olp	0.7	1.9	1.4	3.3	–0.7	0.9	.405
Mandibular incisor, ii/OLp	5.4	2.3	1.8	3.0	3.6	0.9	<.001*
Maxillary molar, ms/Olp	–1.1	1.8	2.5	2.5	–3.6	0.7	<.001* (NP)
Mandibular molar, mi/Olp	5.9	2.6	3.3	2.8	2.6	0.9	<.001* (NP)
Mandibular incisor inclination, IMPA	4.90	9.51	0.84	2.24	4.05	2.69	<.001* (NP)
Maxillary incisor inclination, U1-SN	–3.06	13.39	0.18	1.80	–3.24	2.78	.159 (NP)
Facial convexity, G-Sn-Pg (°)	–3.2	3.0	–	–	–	–	–
Upper facial height, N-ANS	0.96	1.47	1.87	2.20	–0.90	0.60	.353 (NP)
Total facial height, N-Me	4.18	2.37	2.02	2.70	2.16	0.86	.033* (NP)
Facial height ratio, UFH:TFH	–0.01	0.01	0.01	0.03	–0.02	0.01	.016* (NP)

[a] MARA indicates Mandibular Anterior Repostioning Appliance; NP, using nonparametric (Mann-Whitney *U*) test; SD, standard deviation; SE, standard error; T1, time 1; T2, time 2.

*$P < .05$; – Missing data.

The overjet at T1 had a significantly strong, negative correlation with the changes of overjet and had a moderate, negative correlation with molar relation, maxillary incisor, and maxillary molar. Also, the overjet at T1 had a moderate positive correlation with mandibular incisor (Table 3).

DISCUSSION

The MARA was introduced with the intention of creating an equally effective appliance without the associated problems that seemed to develop from use of the Herbst appliance. In this study, as in another study,[8] the Class II sagittal relationship was corrected

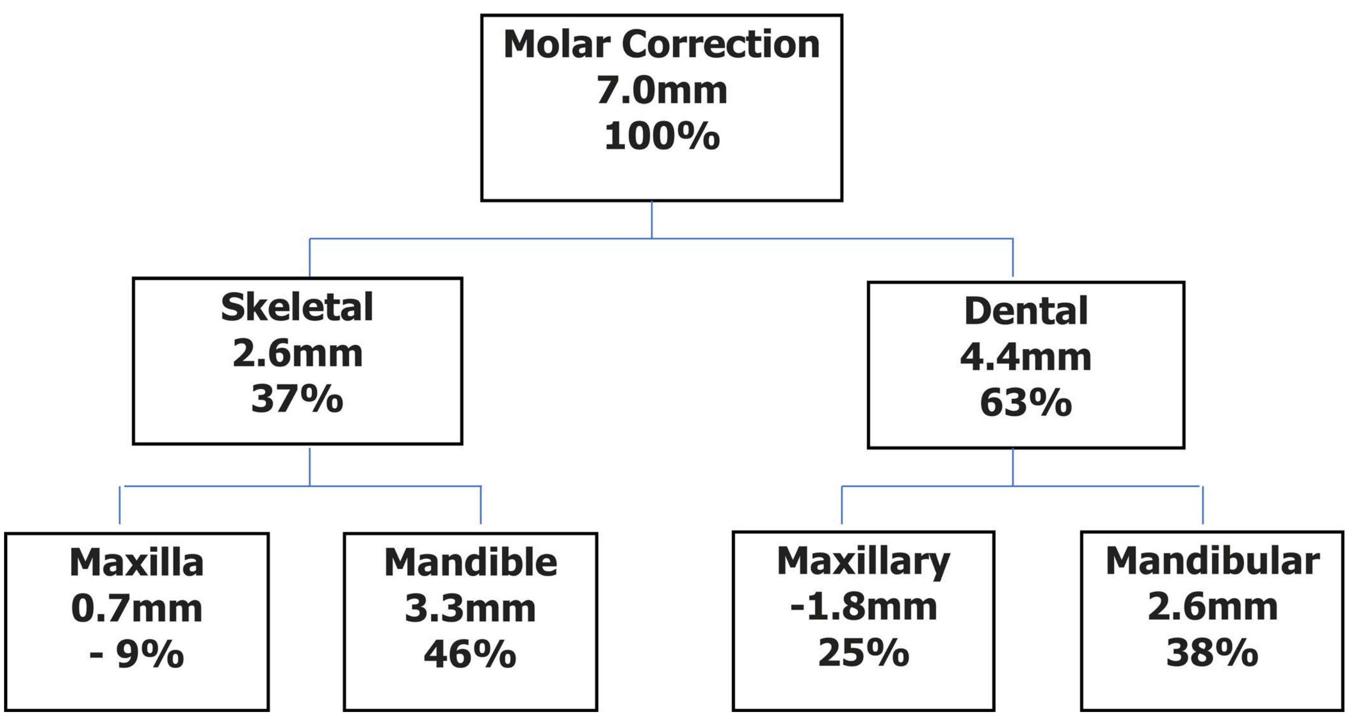

Figure 2. Maxillary and mandibular skeletal and dental changes contributing to molar correction after Mandibular Anterior Repostioning Appliance treatment.

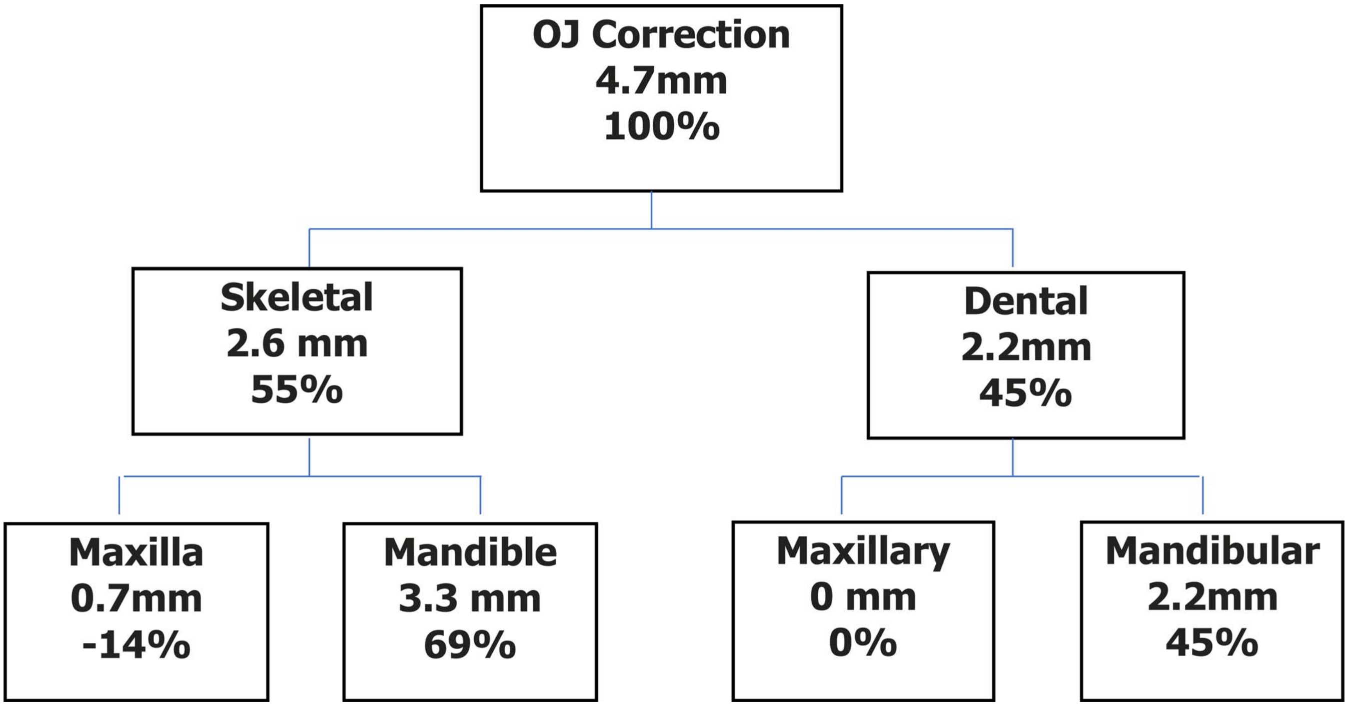

Figure 3. Maxillary and mandibular skeletal and dental changes contributing to overjet correction after Mandibular Anterior Repostioning Appliance treatment.

through a combination of skeletal and dental changes. Mandibular changes were greater at the base than the overall length, being 2.2 mm and 1.8 mm, respectively. This suggested that the bone remodeling response to the appliance was greater in the body of the mandible than in the condylar-glenoid fossa region. Pancherz found a 2.3-mm increase with the Herbst appliance during a 6-month period.[5] There have been contrasting findings in the literature for changes in mandibular size, measured as Co-Gn, ranging from 2.7 mm to 0.46 mm.[8] Meta-analysis of seven studies on short- and long-term effects of the MARA on mandibular length concluded that there was a significant increase in total mandibular length (1.16 mm/y) but a nonsignificant increase in corpus length (0.21 mm/y).[10] In a meta-analysis of short-term effects of fixed and removable functional appliances, Vaid et al.[11] reported additional mandibular length changes of 2.29 mm for fixed and 1.61 mm for removable groups. In a meta-analysis, Marsico et al.[13] concluded that, overall, the increase in mandibular length for functional appliance was statistically significant but not clinically significant at 1.79 mm greater than that for the control group.

Table 3. Pearson Correlation Coefficient (*r*) for the Relationship Between Overjet at Time 1 and the Changes of Different Measurements

Variables	*r*	*P* Value
Overjet	–0.788	<.001*
Molar relation	–0.551	<.001*
Maxillary base	–0.096	.571
Mandibular base	0.278	.095
Condylar head	–0.089	.599
Mandibular length	0.213	.205
Maxillary incisor	–0.335	.043*
Mandibular incisor	0.480	.003*
Maxillary molar	–0.403	.013*
Mandibular molar	0.276	.099
Mandibular incisor inclination	0.130	.445
Maxillary incisor inclination	–0.317	.056

* Correlation is significant at the .05 level.

A restraining or headgear-type effect on the maxilla was not seen as reported with the Herbst.[16] Some studies have reported slight maxillary restriction with the MARA depending on age of the patient and whether the SNA or Co-A point is used as a measurement.[8,9,17–19] Remodeling of A-point could induce errors.[9] In a systematic review, Vaid et al.[11] concluded that functional appliances had little or no effect on the maxilla.

Dental movements of both the maxillary and mandibular molars were significant contributors to the Class II correction. Other studies have reported maxillary molar distalization ranging from 2.4 mm to 1.07 mm with the MARA and 2.84 mm for fixed appliances as a group.[8,9,11,17–19] Mandibular molar protraction has been reported from 1.2 mm to 0.7 mm, which is much less than the amount found in the present study.[8,9,11,17–19] The mandibular incisors came forward an average of 2.2 mm, contributing to 45% of the overjet correction, and proclined 4.9°. Pangrazio-Kulbersh et al.[8] reported no change in incisor protrusion but a similar increase in IMPA angle of 3.9°. In contrast, Chiqueto et al.[17] found slightly less protrusion (1.73 mm) but more proclination (5.0%) than we found in the present study. Gonner et al.[20] observed a 3.6° labial inclination in adolescents when the MARA was used concurrently with a fixed appliance. Systematic reviews of fixed functional appliances have reported an average of 1.34 mm protrusion of mandibular incisors.[11] From a clinical perspective, proclination is often an undesirable consequence of functional appliances. Use of high-torque brackets (+17°) on the maxillary anterior teeth and low-torque brackets (–6°) on the mandibular anterior teeth would help counteract this side effect of the MARA.[9]

Similar to its effect on the maxillary base, the MARA appeared to have a negligible effect on the maxillary incisors. However, some studies have shown retrusion with retroclination.[17] A statistically and clinically significant increase in lower facial height was seen, as in other studies.[8] This occurred due to the advancement of the mandible along the mandibular plane. Thus, no significant increase in the mandibular plane angle was seen. Ruf and Pancherz[21] found no significant differences in the mandibular plane angulation in patients with hypodivergence, normodivergence, and hyperdivergence treated with the Herbst appliance. Careful consideration should be used when selecting appliances for patients with a dolicocephalic facial type.

Soft-tissue considerations and profile improvements are important factors to consider when choosing a Class II correction method. Reduction in soft-tissue convexity was attributed to the forward positioning of pogonion.

There has been extensive research and debate on how Class II functional appliances and correctors work. Results are inconsistent between animal studies and human subjects. Lack of success may be due to poor patient cooperation, the appliance not being worn 24 hours, and inability to control the amount and direction of mandibular growth. Overall, these appliances may not be as effective as initially thought. All appliances seem to give similar long-term results.[9] Reasons for some of the inconsistency in results are clinician experience, patient age, and cephalometric analyses used.[9,11–13]

The particular reference system used was selected for this study for several reasons. First, the reference grid constructed was close to the anatomical area being studied. Second, all of the linear registrations were recorded from the same line (OLp), making it possible to evaluate the relationship between the dental and skeletal changes in each jaw and between the jaws. In addition, by utilizing the original OL and OLp for initial and subsequent measurements, tipping of the occlusal plane (OL plane) during the treatment period did not influence the reference system and bias the measurements. Finally, as Pancherz[5] stated, the grid eliminated the effects of potential growth changes that could adversely affect angular measurements.

CONCLUSIONS

- The MARA is effective in the treatment of Class II malocclusion, resulting in a significant decrease in overjet and correction of the Class II molar relationship.
- Improvement is primarily the result of dental effects of the mandibular incisor and molar and maxillary molar.
- There is a small contribution from a skeletal effect on the mandible.
- There is no skeletal effect on the maxilla.
- There is no dental effect on the maxillary incisor.

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REFERENCES

1. Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. *Int J Adult Orthodon Orthognath Surg*. 1998;13:97–106.
2. McNamara JA Jr. Components of Class II malocclusion in children 8-10 years of age. *Angle Orthod*. 1981;51:177–202.
3. Graber TM, Rakosi T, Petrovic AG. *Dentofacial Orthopedics with Functional Appliances*. St Louis, Mo: Mosby; 1997.
4. Pancherz H. History, background and development of the Herbst appliance. *Semin Orthod*. 2003;9:3–11.
5. Pancherz H. The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. *Am J Orthod*. 1982:82;104–113.
6. Toll DE, Popović N, Drinkuth N. New strategies for Class II fixed functional orthodontics, including MRI diagnostics, manual functional analysis and ophysiotherapy. In Naretto S, ed. *Principles in Contemporary Orthodontics*. London, UK: IntechOpen Limited; 2011:327–336.
7. Eckhart JE. The mandibular anterior repositioning device. In: Papadopoulos MA, ed. *Orthodontic Treatment of the Class II Noncompliant Patient: Current Principles and Techniques*. Philadelphia, Pa: Mosby Elsevier; 2006:107–119.
8. Pangrazio-Kulbersh V, Berger JL, Chermak DS, Kaczynski R, Simon ES, Haerian A. Treatment effects of the mandibular anterior repositioning appliance on patients with Class II malocclusion. *Am J Orthod Dentofacial Orthop*. 2003:123:286–295.
9. Siara-Olds NJ, Pangrazio-Kulbersh V, Berger J, and Bayirli B. Long-term dentoskeletal changes with the bionator, Herbst, Twin Block, and MARA functional appliances. *Angle Orthod*. 2010:80;18–29.

10. Al-Jewair TS. Meta-analysis on the mandibular dimensions effects of the MARA appliance in patients with Class II malocclusions. *Angle Orthod*. 2015:85:706–714.
11. Vaid NR, Doshi VM, Vandekar MJ. Class II treatment with functional appliances: a meta-analysis of short-term treatment effects. *Semin Orthod*. 2014:20;324–338.
12. Cozza P, Baccetti T, Franchi L, De Toffol L, McNamara JA Jr. Mandibular changes produced by functional appliances in Class II malocclusion: a systematic review. *Am J Orthod Dentofacial Orthop*. 2006:129;599.e1–599.e12.
13. Marsico E, Gatto E, Burrascano M, Matarese G, Cordasco G. Effectiveness of orthodontic treatment with functional appliances on mandibular growth in the short term. *Am J Orthod Dentofacial Orthop*. 2011;139:24–36.
14. You Q, Hägg U. A comparison of three superimposition methods. *Eur J Orthod*. 1999:21:717–725
15. Bogdan F. The MARA, a noncompliance solution. *ORMCO Clin Impressions* 2006:15;28–1532.
16. Pancherz H, Pancherz MA. The headgear effect of the Herbst appliance: a cephalometric long-term study. *Am J Orthod*. 1993:103;510–520.
17. Chiqueto K, Henriques JF, Barros SE, Janson G. Angle Class II correction with MARA appliance. *Dent Press J Orthod*. 2013;18:35–44.
18. Ghislanzoni LT, Toll DE, Defraia E, Baccetti T, Franchi L. Treatment and posttreatment outcomes induced by the mandibular advancement repositioning appliance; a controlled clinical study. *Angle Orthod*. 2011;81:684–691.
19. Pangrazio MN, Pangrazio-Kulbersh V, Berger JL, Bayirli B, Movahhedian A. Treatment effects of the mandibular anterior repositioning appliance in patients with Class II skeletal malocclusions. *Angle Orthod*. 2012;82:971–977.
20. Gonner U, Ozkan V, Jahn E, Toll DE. Effect of the MARA appliance on the position of the lower anteriors in children, adolescents and adults with Class II malocclusion. *J Orofac Orthop*. 2007:68:397–412.
21. Ruf S, Pancherz H. The effect of Herbst appliance treatment on the mandibular plane angle: a cephalometric roentgenographic study. *Am J Orthod Dentofacial Orthop*. 1996:110: 225–229.